

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
RAYNOR

Serial No. **Not yet assigned**

Filing Date: **Herewith**

For: **SOLID STATE IMAGE SENSORS
AND MICROLENS ARRAYS**

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PATENT AND TRADEMARK OFFICE, P.O. BOX 2327,
ARLINGTON, VA 22202.**

) EXPRESS MAIL NO: EL 769467848 US

) DATE OF DEPOSIT: December 6, 2001

) NAME: Dawn Kimler

) SIGNATURE: Dawn Kimler

PRELIMINARY AMENDMENT

Director, U.S. Patent and Trademark Office
Washington, D.C. 20231

Siri

Prior to the calculation of fees and examination of the present application, please enter the amendments and remarks set out below.

In the Drawings:

Submitted herewith is a request for a proposed drawing modification as indicated in red ink to label FIGS. 1-5 as prior art and to brackets to FIGS. 11 and 14 to more clearly delineate the subject matter thereof.

In the Claims:

Please cancel Claims 1 to 10.

Please add new Claims 11 to 44.

11. A solid state image sensor comprising:

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an array of pixels and a corresponding array of microlenses disposed adjacent said array of pixels, positions of said microlenses relative to corresponding pixels varying based upon distances of said corresponding pixels from a central optical axis of the solid state image sensor to substantially eliminate vignetting of light collected by said microlenses;

said array of microlenses being divided into blocks each comprising a plurality of said microlenses, and within at least one of said blocks the positions of said microlenses relative to said corresponding pixels thereof being varied by an equal amount.

12. The solid state image sensor of Claim 11 wherein said microlenses within each of said blocks are substantially equally spaced apart from one another a first distance, and wherein adjacent blocks of microlenses are spaced apart from one another a second distance less than the first distance.

13. The solid state image sensor of Claim 11 wherein said microlenses are substantially equally spaced from one another throughout said array of microlenses, and wherein a plurality of microlenses in each of said blocks at edges thereof are smaller in at least one dimension than said remaining microlenses in each of said blocks.

14. The solid state image sensor of Claim 11 wherein said blocks are substantially rectangular.

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15. The solid state image sensor of Claim 11 wherein said blocks have irregular edges, and wherein said blocks are tessellated to form a substantially continuous array of microlenses.

16. A solid state image sensor comprising:
an array of pixels;
said array of pixels having a first aspect ratio and each of said pixels including a light-sensitive area having a second aspect ratio;
said first aspect ratio being substantially equal to said second aspect ratio.

17. The solid state image sensor of Claim 16 further comprising a corresponding array of microlenses disposed adjacent said array of pixels.

18. The solid state image sensor of Claim 17 wherein positions of said microlenses relative to corresponding pixels vary based upon distances of said corresponding pixels from a central optical axis of the solid state image sensor to substantially eliminate vignetting of light collected by the microlenses.

19. The solid state image sensor of Claim 18 wherein said array of microlenses is divided into blocks each comprising a plurality of said microlenses, and within at least one of said blocks the positions of said microlenses

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relative to said corresponding pixels thereof are varied by an equal amount.

20. An imaging system comprising:

a solid state image sensor comprising

an array of pixels and a corresponding array of microlenses disposed adjacent said array of pixels, positions of said microlenses relative to corresponding pixels varying based upon distances of said corresponding pixels from a central optical axis of said solid state image sensor to substantially eliminate vignetting of light collected by said microlenses,

said array of microlenses being divided into blocks each comprising a plurality of said microlenses, and within at least one of said blocks the positions of said microlenses relative to said corresponding pixels thereof being varied by an equal amount; and

a display for cooperating with said solid state image sensor to display images therefrom.

21. The imaging system of Claim 20 wherein said microlenses within each of said blocks are substantially equally spaced apart from one another a first distance, and wherein adjacent blocks of microlenses are spaced apart from one another a second distance less than the first distance.

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22. The imaging system of Claim 20 wherein said microlenses are substantially equally spaced from one another throughout said array of microlenses, and wherein a plurality of microlenses in each of said blocks at edges thereof are smaller in at least one dimension than said remaining microlenses in each of said blocks.

23. The imaging system of Claim 20 wherein said blocks are substantially rectangular.

24. The imaging system of Claim 20 wherein said block have irregular edges, and wherein said blocks are tessellated to form a substantially continuous array of microlenses.

25. An imaging system comprising:
a solid state image sensor comprising an array of pixels, said array of pixels having a first aspect ratio and each of said pixels including a light-sensitive area having a second aspect ratio, and said first aspect ratio being substantially equal to said second aspect ratio; and
a display for cooperating with said solid state image sensor to display images therefrom.

26. The imaging systems of Claim 25 further comprising a corresponding array of microlenses disposed adjacent of said array of pixels.

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27. The imaging systems of Claim 26 wherein positions of said microlenses relative to corresponding pixels vary based upon distances of said corresponding pixels from a central optical axis of said solid state image sensor to substantially eliminate vignetting of light collected by the microlenses.

28. The imaging systems of Claim 27 wherein said array of microlenses is divided into blocks each comprising a plurality of said microlenses, and within at least one of said blocks the positions of said microlenses relative to said corresponding pixels thereof are varied by an equal amount.

29. A camera comprising:
a housing; and
a solid state image sensor carried by said housing
and comprising

an array of pixels and a corresponding array of microlenses disposed adjacent said array of pixels, positions of said microlenses relative to corresponding pixels varying based upon distances of said corresponding pixels from a central optical axis of said solid state image sensor to substantially eliminate vignetting of light collected by said microlenses,

said array of microlenses being divided into blocks each comprising a plurality of said microlenses, and within at least one of said blocks the positions of said microlenses relative to said

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corresponding pixels thereof being varied by an equal amount.

30. The camera of Claim 29 wherein said microlenses within each of said blocks are substantially equally spaced apart from one another a first distance, and wherein adjacent blocks of microlenses are spaced apart from one another a second distance less than the first distance.

31. The camera of Claim 29 wherein said microlenses are substantially equally spaced from one another throughout said array of microlenses, and wherein a plurality of microlenses in each of said blocks at edges thereof are smaller in at least one dimension than said remaining microlenses in each of said blocks.

32. The camera of Claim 29 wherein said blocks are substantially rectangular.

33. The camera of Claim 29 wherein said blocks have irregular edges, and wherein said blocks are tessellated to form a substantially continuous array of microlenses.

34. A camera comprising:
a housing; and
a solid state image sensor carried by said housing and comprising an array of pixels, said array of pixels having a first aspect ratio and each of said pixels including a light-sensitive area having a second aspect ratio, and said

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first aspect ratio being substantially equal to said second aspect ratio.

35. The camera of Claim 34 further comprising a corresponding array of microlenses disposed adjacent said array of pixels.

36. The camera of Claim 35 wherein positions of said microlenses relative to corresponding pixels vary based upon distances of said corresponding pixels from a central optical axis of said solid state image sensor to substantially eliminate vignetting of light collected by the microlenses.

37. The camera of Claim 36 wherein said array of microlenses is divided into blocks each comprising a plurality of said microlenses, and within at least one of said blocks the positions of said microlenses relative to said corresponding pixels thereof are varied by an equal amount.

38. A method for substantially eliminating vignetting of light collected by microlenses disposed adjacent an array of pixels in a solid state image sensor, the method comprising:

varying positions of the microlenses relative to corresponding pixels based upon distances of the corresponding pixels from a central optical axis of the solid state image sensor;

dividing the microlenses into a plurality of blocks of microlenses; and

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varying positions of a plurality of microlenses within at least one of the blocks of microlenses relative to corresponding pixels thereof by an equal amount.

39. The method of Claim 38 wherein the microlenses within each of the blocks are substantially equally spaced apart from one another a first distance, and wherein adjacent blocks of microlenses are spaced apart from one another a second distance less than the first distance.

40. The method of Claim 38 wherein the microlenses are substantially equally spaced from one another throughout the array of microlenses, and wherein a plurality of microlenses in each of the blocks at edges thereof are smaller in at least one dimension than the remaining microlenses in each of the blocks.

41. A method for making a solid state image sensor comprising:

forming an array of pixels so that the array has a first aspect ratio, each of the pixels including a light-sensitive area having a second aspect ratio, and the first aspect ratio being substantially equal to the second aspect ratio.

42. The method of Claim 41 further comprising disposing a corresponding array of microlenses adjacent the array of pixels.

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43. The method of Claim 42 wherein disposing comprises disposing the corresponding array of microlenses such that positions of the microlenses relative to corresponding pixels vary based upon distances of the corresponding pixels from a central optical axis of the solid state image sensor to substantially eliminate vignetting of light collected by the microlenses.

44. The method of Claim 43 further comprising: dividing the array of microlenses into blocks each comprising a plurality of the microlenses; and varying, within at least one of the blocks, the positions of the microlenses relative to the corresponding pixels thereof by an equal amount.

REMARKS

It is believed that all of the claims are patentable over the prior art. For better readability and the Examiner=s convenience, the newly submitted claims differ from the translated counterpart claims which are being canceled. The newly submitted claims do not represent changes or amendments that narrow the claim scope for any reason related to the statutory requirements for patentability. Accordingly, after the Examiner completes a thorough examination and finds the claims patentable, a Notice of Allowance is respectfully requested in due course. Should the Examiner determine any minor informalities that need to be addressed, he is encouraged to contact the undersigned attorney at the telephone number below.

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Respectfully submitted,



JOHN F. WOODSON, II
Reg. No. 45,236
Allen, Dyer, Doppelt, Milbrath
& Gilchrist, P.A.
255 S. Orange Avenue, Suite 1401
Post Office Box 3791
Orlando, Florida 32802
407-841-2330
407-841-2343 fax
Attorneys for Applicant

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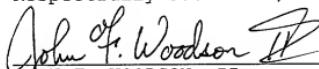
SUBMISSION OF PROPOSED MODIFICATIONS TO DRAWINGS

Director, U.S. Patent and Trademark Office
Washington, D.C. 20231

Sir:

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Respectfully submitted,



JOHN F. WOODSON, II
Reg. No. 45,236

Allen, Dyer, Doppelt, Milbrath
& Gilchrist, P.A.
255 S. Orange Ave., Suite 1401
P. O. Box 3791
Orlando, Florida 32802
(407) 841-2330
Attorney for Applicant

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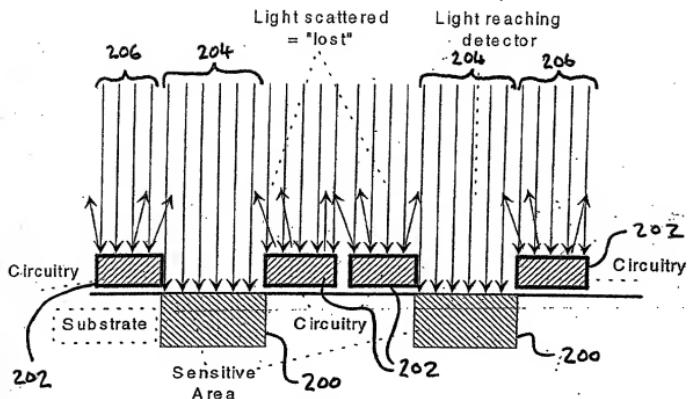


Figure 1 Pixel's circuitry obscures sensitive area (PRIOR ART).

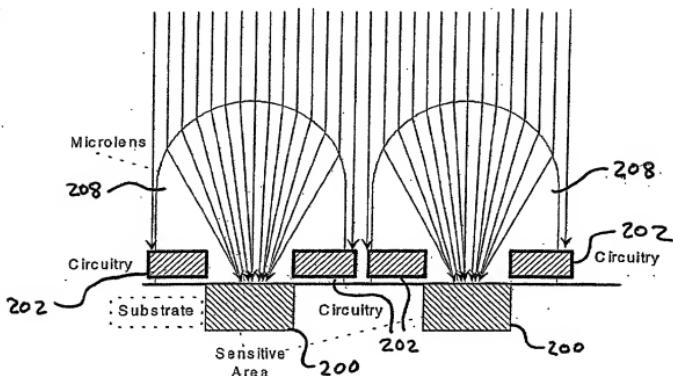


Figure 2 Microlens focuses most of the light on sensitive area
(PRIOR ART)

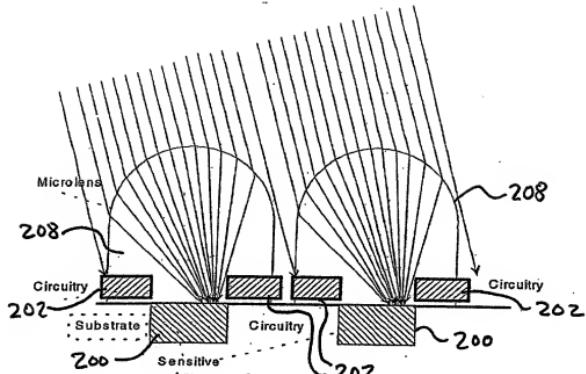


Figure 3 Off axis illumination
(PRIOR ART)

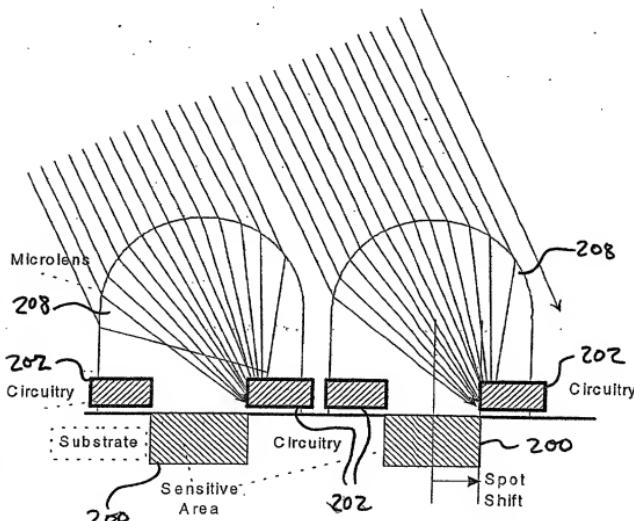


Figure 4 Off-axis illumination with Vignetting
(PRIOR ART)

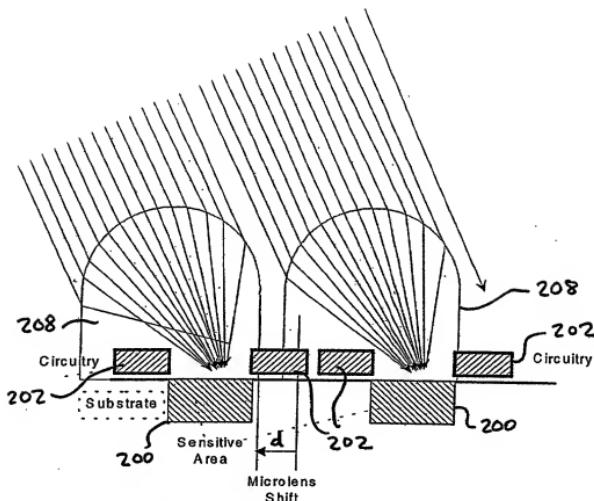


Figure 5 Off-axis illumination with shifted microlens
(PRIOR ART)

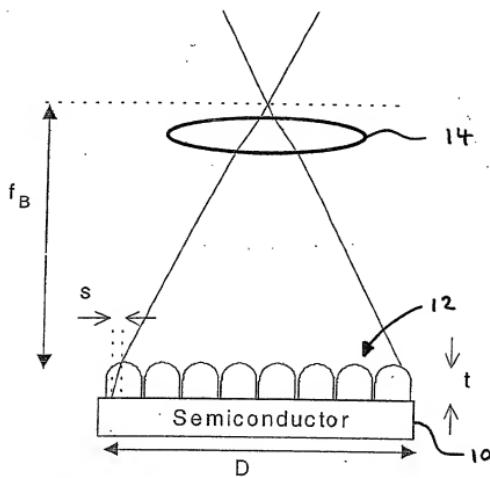


Figure 6 Microlens Shift Approximation

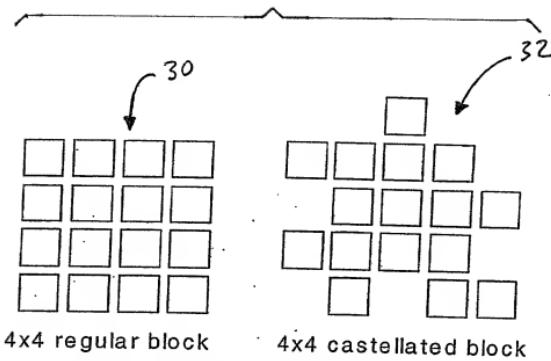


Figure 11 Regular and castellated blocks

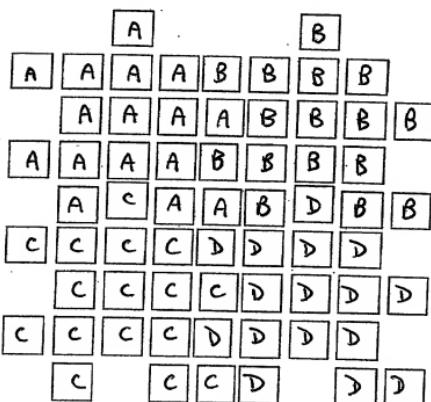


Figure 12 Narrow gaps using castellated blocks

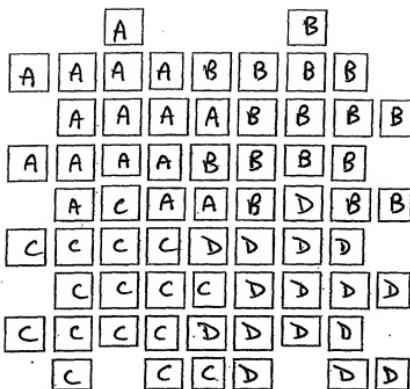
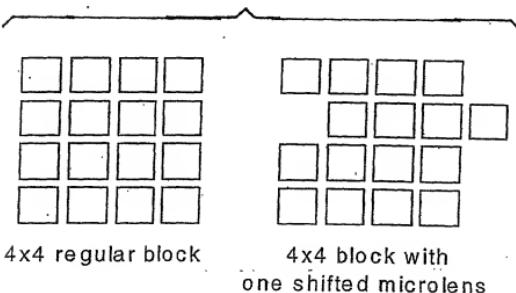


Figure 13 Varying microlens sizes with castellated blocks



4x4 regular block

4x4 block with
one shifted microlens

Figure 14 Modified block which tessellates